

Socioeconomic Risk Factors for Asthma in Chilean Young Adults

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The relation between socioeconomic status (SES) and asthma is not well understood. It is accepted that there is a negative association between SES and severity of asthma,^{1–5} but the association between SES and asthma prevalence is unclear. Recent national surveys in the United States and Europe have reported that low SES is a major risk factor for asthma prevalence,^{6,7} but other reports show that this association is far from consistent.^{8–13}

ASTHMA DEFINITIONS AND INDICATORS OF SES

Heterogeneity in asthma definitions and the choice of SES indicators could partially account for reported risk factor inconsistencies. Most studies have been based on self-reported asthma symptoms only, which might be an imprecise way of assessing asthma. Symptom perception might be influenced by educational and cultural patterns,¹⁵ and the meaning of these symptoms depends on language, as demonstrated in several studies, especially in relation to wheezing.^{16–18} Important differences in the relation between SES and asthma have also been reported depending on whether asthma is defined as atopic or nonatopic asthma.¹⁹

SES is an aggregate concept that takes into account material and social resources and the individual's ranking in the social hierarchy. Thus, it is a multidimensional concept, and no single measure can fully account for a person's SES. It is advisable to use multiple SES indicators for understanding the possible effects of SES on health.²⁰ Most of the studies of asthma have used a single indicator, such as education, occupation, income, or neighborhood characteristics.^{19,21–23} Thus, the association between SES and asthma appears oversimplified in the asthma literature.

The theoretical framework of the hygiene hypothesis in relation to atopic conditions has added an extra layer to our understand-

Objectives. We studied the association between socioeconomic status (SES) and asthma symptoms, severity of asthma, atopy, and bronchial hyperresponsiveness (BHR) to methacholine.

Methods. We studied 1232 men and women born between 1974 and 1978 in a semirural area of Chile. We assessed asthma symptoms with a standardized questionnaire, atopy with a skin-prick test to 8 allergens, and BHR to methacholine with the tidal breathing method. SES was derived from several indicators: education, occupation, completion of a welfare form, belongings, housing, number of siblings, and overcrowding.

Results. Those with fewer belongings had more asthma symptoms. Those who had higher education and those who owned cars had fewer asthma symptoms and BHR. Overcrowding was negatively related to atopy, atopy with asthma symptoms, and BHR. Higher education and noncompletion of a welfare form were risk factors for atopy.

Conclusion. The strength and direction of the association between asthma and SES depended on what definition of asthma was analyzed. Asthma symptoms were more common among poor people. There was some support for the hygiene hypothesis, as overcrowding was associated with less wheezing with atopy, less atopy, and less BHR. (*Am J Public Health.* 2005;95:1375–1381. doi:10.2105/AJPH.2004.048967)

ing of the association between SES and asthma. The hygiene hypothesis proposes that the development of allergy and asthma can be prevented by a shift from T-helper type 2 cells (T_H2) dominance to T-helper type 1 cells (T_H1) dominance, which can be induced by exposure to immune stimulants such as viruses, bacteria, and endotoxins, during the prenatal period or early childhood.²⁴ As these exposures are more prevalent in poor than in wealthy settings, and in overcrowded environments, it would be expected that asthma would be more prevalent in higher SES groups.

SES AND ASTHMA IN DEVELOPING COUNTRIES

Our current understanding of the association between SES and asthma mainly is based on studies carried out in developed countries.^{13,25} If material conditions have a direct impact on asthma and its severity, we would expect that the strength of the associa-

tion between SES and asthma would be more striking in countries with high rates of poverty, such as developing countries. The few reports from developing countries published so far have concluded that higher-SES groups are more at risk for asthma than are lower SES groups,²⁶ although there is a suggestion that, within the more severe cases of asthma, low SES may play a role.²³

We have carried out a study of SES and asthma in Chile, a middle-income country characterized by a markedly unequal distribution of wealth.²⁷ Women, as a group, have a lower SES than men. The prevalence of asthma symptoms in Chile, such as wheezing in the last 12 months, varies from 17.8% in 6- and 7-year-old children to 10.2% in 13- and 14-year-old children and is similar in both genders.²⁸ There is not equivalent information on asthma prevalence in adults, as all the studies have used a nonstandardized questionnaire. We assessed asthma symptoms with a standardized questionnaire, atopy with a skin-prick test to 8 allergens, and BHR to

methacholine with the tidal breathing method. We also collected information on several SES indicators. Our approach allowed us to study the association between SES and asthma with subjective and objective assessments of asthma and several SES variables. The focus of our analysis was the relation between SES and asthma; as a byproduct of our analysis, we were able to explore the hygiene hypothesis.

METHODS

Population

We collected information between January 2001 and April 2003 from a sample of 1232 men and women randomly selected from a total of 3096 live births between 1974 and 1978 in the maternity unit of the Hospital of Limache, Chile. Limache is a semirural community of approximately 40 000 inhabitants with a relatively low emigration to other parts of the country.³⁰ Agriculture is its main source of wealth, and poverty in Limache broadly corresponds to the median for Chile.³¹

Asthma Definitions

We used 6 asthma definitions: (1) wheezing in the last 12 months; (2) wheezing and waking up with breathlessness or breathlessness at rest, either in the last 12 months; (3) wheezing in the last 12 months by skin sensitization status; (4) asthma ever, corresponding in 95% of the cases to physician-diagnosed asthma; (5) atopic status; and (6) BHR to methacholine. We chose the asthma symptoms commonly reported in the medical literature. Sensitization is a characteristic frequently associated with asthma, but also with other conditions such as eczema and hay fever. We developed an asthma severity variable based on wheezing and breathing problems. Those with wheezing and frequent breathing problems were classified as having severe or moderate asthma; the rest were classified as having mild asthma. All the asthma-related definitions assessed by asthma symptoms were considered subjective measurements, whereas all the information assessed by skin tests or BHR were considered objective measures.

Measurements

We used the Spanish version of the European Community Respiratory Health Survey questionnaire, adapted to the Chilean lexicon. The validity and reliability of the asthma symptoms in the questionnaire have already been assessed.³² We assessed skin test sensitizations to cat fur, dog hair, cockroaches, *Dermatophagoides pteronyssinus* (a type of house dust mites), *Alternaria alternata* (an important cause of mold allergies in humans), and blends of pollens from grasses, trees, weeds, and shrubs common in Chile, all manufactured by Allergy Therapeutics Ltd., (Worthing, West Sussex). We considered a welt size of at least 3 mm to be positive, and as advised by Chinn et al., we did not adjust the welt size for histamine control.³³ We assessed a BHR to methacholine with the tidal breathing method.³⁴ Increasing concentrations of 0.5, 1, 4, 8, and 16 mg/mL were used with a Hudson Micro Mist Nebulizer (Hudson RCI, Temecula, Calif.) at a flow rate of 0.13 L/min over a 2-minute period. Forced expiratory volume at 1 second (FEV₁) was measured with a Vitalograph 2120 (Vitalograph Ltd., Buckingham, England) and Spirotrac IV software (Vitalograph Ltd.) following the American Thoracic Society specifications.³⁵ A participant with an FEV₁ decrease of 20% in comparison to baseline FEV₁ at any concentration up to 16 mg/mL (PC₂₀) was considered to have a positive BHR. Participants were advised not to smoke or take asthma relievers and preventives for at least 1 and 6 hours, respectively, before the test. Those with a predicted FEV₁ below 70% at baseline and those with a heart condition, with epilepsy, who were currently pregnant, or who were breastfeeding were excluded. The tests and measurements were carried out in a health setting with ready access to medical attention. Three specially trained university nurses carried out all assessments under the supervision of a physician. The same nurses administered the questionnaires.

Socioeconomic Status Factors

We considered the following types of SES variables: education, occupation, completion of a welfare form, and material belongings.³⁶ We also measured 2 sociodemo-

graphic characteristics: number of siblings and overcrowding. This multidimensional approach is particularly appropriate in Chile, because the process of economic independence at age 24 to 28 years from parents has frequently not been completely achieved and the SES in semirural areas is less well known.

Education is a proxy measurement of people's potential in the marketplace; in this study, education was measured as years of full-time education by participants and their parents. The head of the household's occupation was considered an indicator of social class, power, prestige, and ability to have access to a better environment. Occupations were divided into 3 categories: professionals, tradespeople, and clerks; skilled manual workers; and unskilled workers (the highest, middle, and lowest categories, respectively). As an indirect proxy of income, we asked the participants whether they had completed a governmental welfare form. Beneficiaries of this governmental welfare program receive support in terms of cash transfers and housing subsidies. This program does not include free access to health care.

We used 3 measures of material belongings: the number of domestic appliances, such as gas-fueled water-heating devices, personal computers, refrigerators, washing machines, and microwave ovens; car ownership; and a combined index of type of tenancy and quality of housing. The categories for type of tenancy were owner, leaseholder, nonpaying occupancy, and squatter. The quality of the house was divided into solid materials, wooden materials, and light or precarious materials. We used a combined index because, in Chile, some people may own a poor-quality 1-room house, which reflects poor living conditions, whereas other people may be renting a solid, good-quality house. Housing provides an index of the level of deprivation. We also considered 2 sociodemographic characteristics: number of siblings and overcrowding, which we defined as number of people per room, excluding bath and kitchen. Reproductive behavior and number of people sharing facilities are associated with SES and may reflect infectious patterns related to those patterns postulated in the hygiene hypothesis.

Other Variables

Age, gender, active smoking, passive smoking, birthweight, and body mass index were included in the analysis as potential confounders of the association between SES and asthma. Current smokers were those who smoked at least 1 cigarette a day in the last month. If a participant was a smoker, we asked for the number of cigarettes smoked per day. Passive smoking was based on the regular exposure to environmental tobacco smoke in the last 12 months and the average number of hours per day of exposure. Birthweight was obtained from the maternity registry book in Limache and verified in the clinical notes. The 3 nurses used standardized procedures to measure height and weight.³⁷

Statistical Analyses

Descriptive statistics are given by gender to illustrate the differences related to asthma and SES, because Chilean women as a group tend to have a lower SES than men. The Kendall τ -b coefficient was used to assess the correlation between asthma definitions and SES variables. Separate multiple logistic regressions were carried out for each asthma definition. First, we assessed the association of each definition with a single SES variable, adjusting for age and gender. Second, we developed final models for each definition variable and for each SES variable after adjustment for age, gender, active and passive smoking,

birthweight, and body mass index. We also carried out analysis for each asthma definition in which all SES variables were included initially, then eliminated in sequence those SES variables that were statistically insignificant at $P=.05$, with adjustment for the same variables. Such an analysis allowed us to identify the predominant SES variables in their association with an asthma definition. The Hosmer–Lemeshow goodness-of-fit test was performed to assess whether these models fit the data.³⁸ We tested the possibility of interaction between gender and a single SES variable on each asthma definition.

RESULTS

More women (673) than men (559) participated in the study (Table 1). Positive BHR and asthma, as diagnosed by a physician, were more prevalent in women than in men. Asthma diagnosed by a physician is relatively rare in this population, and use of asthma medications is exceptional. The correlation between asthma symptoms varied between 0.2 and 0.4. The correlation between each asthma symptom and atopy or positive BHR was low (0.1 or less) (data not shown).

Women were more likely to apply for welfare support, more likely to live in more precarious and overcrowded housing, and less likely to own a car than men (Table 2). The participants' parents had a median of 4

years less full-time education than the participants in the study. The level of correlation between SES variables ranged, with few exceptions, from 0.1 to 0.4. The correlation between parents' full-time education was 0.4, whereas the correlation of the participant's education with each of the parents was about 0.28 (Table 3).

Those possessing fewer household belongings were more likely to have asthma symptoms (wheezing, $P<.05$, or wheezing and another asthma symptom, $P<.001$) (Table 4). Those who did not own a car and were less educated were more likely to report wheezing and another asthma symptom ($P<.05$).

When we used wheezing and frequent breathing problems as a proxy measure of severity, those with fewer belongings in the household had a higher chance of having this combination of respiratory symptoms ($P=.02$). We present only the adjusted models as the odds ratios changed less than 10% after adjustment.

Greater overcrowding appeared to protect against wheezing with atopy ($P=.02$), atopy ($P=.002$), and BHR ($P=.03$) (Table 4). Higher education and not being registered with social services ($P=.01$ and $P=.03$, respectively) were risk factors for atopy. Lack of a private car and less education were risk factors for BHR ($P=.02$ and $P=.003$, respectively). Number of siblings was not associated with any of the asthma definitions. Asthma diagnosed by a physician was unrelated to the SES variables in the study. Two-way interactions, including an SES variable and gender, were statistically insignificant. Results remained the same in the multiple logistic analyses in which all SES factors were included (data not shown). The Hosmer–Lemeshow goodness-of-fit test showed that all the models fit the data well ($P>.05$). With the exception of the model for atopy ($P=.2$), all the models had a P value greater than 0.5.

DISCUSSION

In this study there was a consistent inverse association between number of belongings and asthma symptoms. Higher education and car ownership were associated with fewer asthma symptoms and less BHR, whereas overcrowding was associated with less asthma

TABLE 1—Characteristics of the Sample, and Prevalence of Asthma Symptoms and Bronchial Hyperresponsiveness (BHR) to Methacholine by Gender: Limache, Chile, January 2001 through April 2003

	Men	Women	<i>P</i>
Participants (%)	559 (45.4)	673 (54.6)	.02
Median age, y (interquartile range)	25.0 (24–26)	24.7 (23–26)	.03
Wheezing in last 12 months (%)	144 (26.5)	188 (27.9)	NS
Wheezing and waking up with breathlessness or breathlessness at rest in last 12 months (%)	55 (9.8)	87 (12.9)	NS
Wheezing in last 12 months and atopy (%)	51 (9.1)	56 (8.3)	NS
Atopy (%)	123 (25.7)	164 (24.8)	NS
Positive BHR to methacholine (%)	44 (8.0)	111 (16.9)	<.001
Asthma diagnosed by physician (%)	14 (2.5)	35 (5.2)	.016
Wheezing and frequent breathing problems (%)	18 (3.2)	31 (4.6)	NS

Note. NS = nonsignificant.

TABLE 2—Socioeconomic Distribution of the Sample by Gender: Limache, Chile, January 2001 through April 2003

Socioeconomic Indicators	Men	Women	P
Schooling			
Median years of full-time education of participants (IR)	12 (10-13)	12 (10-13)	NS
Median years of full-time education of mother (IR)	8 (6-10)	8 (5-10)	NS
Median years of full-time education of father (IR)	8 (5-11)	8 (5-11)	NS
Head of household's occupation (%)			
Professional, tradesperson, or employee	115 (20.6)	159 (24.0)	NS
Skilled manual worker	136 (24.4)	142 (21.3)	
Unskilled manual worker	306 (54.9)	367 (54.8)	
Completion of welfare form (%)			
Yes	214 (42)	393 (60.1)	<.001
No	296 (58)	261 (39.9)	
Housing type and ownership status (%)			
Owner of house made of solid materials	98 (17.4)	81 (11.9)	<.001
Owner of wooden house or letting house of solid materials	268 (48.1)	291 (43.5)	
Owner of house of light material or letting wooden house	64 (11.7)	64 (9.5)	
Owner of precarious housing, letting light housing, or nonpaying occupancy of better-quality house	51 (9.2)	98 (14.6)	
Nonpaying occupancy of house of light material or precarious material or squatter	76 (13.6)	137 (20.4)	
Number of household belongings (%)			
3-5	244 (43.8)	328 (48.7)	NS
0-2	313 (56.2)	345 (51.3)	
Car ownership (%)			
Yes	171 (30.6)	162 (24.1)	.01
No	387 (69.4)	511 (75.9)	
Number of siblings (%)			
0-1	76 (13.6)	94 (14)	NS
2-3	244 (43.7)	279 (41.5)	
> 3	238 (42.7)	299 (44.5)	
Number of people per room (excluding bathroom and kitchen) (%)			
< 1	149 (26.8)	124 (18.5)	.01
1-1.5	319 (57.4)	408 (60.9)	
>1.5	88 (15.8)	138 (20.6)	

Note. IR = interquartile range (a few participants were excluded because of missing information); NS = nonsignificant.

in our study than men because men are usually more reluctant to participate and sometimes require permission from their employers, especially during fruit-harvesting periods.

It is difficult to assess SES level in emerging countries in Latin America, and it is even more difficult in age groups that are in the process of acquiring economic independence.³⁶ In this rural setting, it is possible that better-off managerial and professional groups were underrepresented. Thus, the variation between social groups may be narrow in comparison with urban settings. The higher correlation between parents' education than participant's education with each parent, in addition to the increase in median number of years of full-time education, indicates that a moderate level of social mobility was operating in this community. We did not use income as a variable because in our age group household and personal income may be misleading as they depend on whether the participants are living with their family of origin.

Asthma Symptoms and SES Indicators

In our study, indicators of low SES such as fewer belongings, less education, and not having a car were related to asthma symptoms. This has not been the prevailing finding in developing countries, in which analyses have shown a lack of association between SES and asthma or an increased prevalence in better-off participants.^{23,40-42} However, our study, in contrast to the others in developing countries, was carried out in adults. Smoking, a widespread behavior in Chile and a powerful cause of wheezing, may have influenced the results despite adjustment for it in our analysis. It is also known that lower SES is associated with a low self-perception of health, higher degrees of somatization, and depression, and this might exaggerate the prevalence of asthma symptoms in our study.^{43,44} Somatization, anxiety, and depression are common in Chile, and these conditions are known to be associated with lower SES.⁴⁵

Objective Measures Associated With Asthma and SES Indicators

When we used objective definitions of asthma, overcrowding emerged as consistently associated with less asthma symptoms with atopy, less atopy, and less BHR. A Brazilian study of children also reported an association

with atopy, less atopy, and less BHR. Higher education and noncompletion of a welfare form were risks factors for atopy. The effect of education on asthma was small in comparison with SES indicators related to material resources and sociodemographic variables such as overcrowding.

Strengths and Weaknesses of the Study

The strengths of this study are that we used several SES measures to assess asthma definitions and used perception of asthma symp-

toms and objective measures of asthma such as BHR and atopy. The use of several SES variables was justified, as the correlations between SES measures were at most moderate. The data collected were almost complete, and assessments were made with standardized procedures carried out by trained professionals. The cohort studied was born at the time in which infant mortality was approximately 50 per 1000 in Chile.³⁹ Thus, some of the poorest members of the cohort did not reach adulthood. There were slightly more women

TABLE 3—Correlation Between Socioeconomic Variables (Kendall's τ -b): Limache, Chile, January 2001 through April 2003

	Maternal Schooling (n = 1129)	Paternal Schooling (n = 1052)	Head of Household's Occupation (n = 1200)	Completion of Welfare Form (n = 1164)	Housing (n = 1228)	Belongings (n = 1230)	Car Ownership (n = 1231)	Number of Siblings (n = 1230)	Overcrowded Household (n = 1226)
Participant schooling (n = 1231)	0.287	0.273	0.334	-0.090	0.198	0.426	0.178	-0.218	-0.215
Maternal schooling	...	0.404	0.189	-0.076	0.115	0.264	0.153	-0.187	-0.129
Paternal schooling	0.209	-0.107	0.134	0.256	0.101	-0.163	-0.088
Head of household's occupation	-0.114	0.165	0.320	0.208	-0.124	-0.205
Completion of welfare form	-0.064	-0.169	-0.112	-0.100	0.147
Housing	0.238	0.114	-0.100	-0.277
Belongings	0.286	-0.182	-0.215
Car ownership	-0.100	-0.109
Number of siblings	0.120

Note. All pairs of correlations were significant at $P < .05$.

TABLE 4—Association Between Socioeconomic Variables and Asthma Symptoms, Atopy, and Bronchial Hyperresponsiveness (BHR), Adjusted for Age, Gender, Smoking, Passive Smoking, Birthweight, and Body Mass Index: Limache, Chile, January 2001 through April 2003

	Wheezing (n = 1208), OR (95% CI)	Wheezing and Another Asthma Symptom (n = 1208), OR (95% CI) ^a	Wheezing and Frequent Breathing Problems (n = 331), OR (95% CI)	Wheezing with Atopy (n = 1208) OR (95% CI)	Atopy (n = 1194), OR (95% CI)	BHR (n = 1182), OR (95% CI)	Asthma Ever (n = 1208), OR (95% CI)
Full-time education y ^b	0.98 (0.93, 1.02)	0.93 (0.88, 0.99)*	0.95 (0.85, 1.07)	1.02 (0.94, 1.10)	1.06 (1.01, 1.18)*	0.91(0.85, 0.97)*	0.99 (0.89, 1.10)
Completion of welfare form, yes (Ref = no)	1.24 (0.94, 1.62)	1.07 (0.74, 1.56)	0.88 (0.46, 1.70)	0.75 (0.49, 1.14)	0.74 (0.56, 0.98)*	0.84 (0.59, 1.21)	0.85 (0.47, 1.55)
Domestic belongings, 0-2 (Ref = 3-5)	1.40 (1.08, 1.83)*	1.66 (1.16, 2.39)**	2.19 (1.18, 4.27)*	1.13 (0.75, 1.69)	0.92 (0.71, 1.20)	1.18 (0.83, 1.70)	0.86 (0.48, 1.54)
Car ownership, no (Ref = yes)	1.03 (0.99, 1.07)	1.08 (1.01, 1.15)*	1.78 (0.79, 4.04)	1.39 (0.86, 2.26)	1.05 (0.71, 1.27)	1.66 (1.08, 2.55)*	0.83 (0.44, 1.58)
Overcrowding (Ref = <1) ^c							
1-1.5	0.90 (0.65, 1.25)	1.05 (0.66, 1.67)	1.71 (0.73, 4.01)	1.12 (0.68, 1.83)	1.03 (0.73, 1.38)	1.16 (0.76, 1.77)	0.94 (0.46, 1.93)
>1.5	0.99 (0.66, 1.49)	1.22 (0.69, 2.14)	1.46 (0.50, 4.22)	0.53 (0.25, 0.93)*	0.56 (0.36, 0.88)**	0.55 (0.30, 1.03)*	0.67 (0.25, 1.80)

Note. OR = odds ratio; CI = confidence interval.

^aWaking up with breathlessness or breathlessness at rest.

^bOR is for each additional year of education.

^cOvercrowding estimated as people per room, excluding bathroom and kitchen.

* $P < .05$; ** $P < .001$.

of asthma symptoms with low overcrowding and high SES.⁴² Overcrowding would be related to a closer contact among people and to a higher risk of infections, and therefore, this association would support the hygiene hypothesis.¹⁴ A caveat to our findings is that the hygiene hypothesis is more relevant to events occurring in childhood, and our measure is about current overcrowding and may not necessarily correspond to overcrowding in

childhood. However, an Italian study in young servicemen showed that immunity to orofecal microbes conferred protection against asthma.⁴⁶ This would indicate that lack of cleanliness might be a protective factor for asthma beyond childhood and could explain our findings. We didn't find an association between number of siblings and any of the objectives measures of asthma. It is possible that in an environment in which large

families were the norm as in Chile in the 1970s, overcrowding might be a better proxy measure for exploring the hygiene hypothesis.

Indicators of a higher SES such as higher education and no completion of a welfare form were also risk factors for atopy. Registration with social services may be an indicator of poverty. In Chile, this system has been an important mechanism for redistributing wealth to the poorest people through cash

transfers and housing subsidies. Health benefits are not part of this welfare program, but the program may still influence health status. In general, Chileans have access to medical care, but the quality of health care is variable. A caveat in our information is that it relates to data on registration but not on the results of the application.

In contrast, the association found between BHR and more years of full-time education and access to a car supported the interpretation that a better SES protects against BHR. We are not aware of other studies conducted in developing countries that have specifically assessed the relation between SES and BHR.

We believe that our results highlight the lack of consistency in the meaning associated with asthma characteristics. Fewer material resources and low educational level were risk factors for asthma symptoms, but overcrowding was consistently related to asthma as measured objectively, giving some support to the hygiene hypothesis. Atopy and BHR, although related, differ, as atopy is related not only to asthma but also to hay fever and eczema, whereas positive BHR is a more specific characteristic of asthma. Our results might support the view that atopic or nonatopic asthma would correspond to 2 independent diseases.¹⁹

Severity of Asthma and SES Factors

As in previous reports, we found that lower SES was associated with severe asthma.^{1,2,5} The association between low SES and severe asthma in other studies has been explained by exposure to poorer environments, poor recognition of asthma, poor access to medical facilities, undertreatment of the condition, and low concordance in the management of the condition among those with a lower SES level.^{47,48} However, these explanations do not apply to our study because Limache was a semirural area with low levels of air pollution; asthma diagnosed by a physician was infrequent, just 4% in the total sample; and management of asthma was almost nonexistent in our study. Access to asthma management is poor in Limache, regardless of SES. Furthermore, we are uncertain about the validity of our severe asthma variable as it is strange that so few in this group were atopic or had a positive BHR.

Conclusions

In a semirural population in a middle industrial economy, SES indicators related to material resources and a sociodemographic variable such as overcrowding were distinctly associated with different asthma definitions. At one level, a higher standard of living appeared to protect people from asthma symptoms and BHR, whereas it was a risk factor for atopy. At another level, there was a negative association between overcrowding and asthma with atopy, atopy on its own, and BHR, showing that the hygiene hypothesis may have a role in this kind of setting. Our study demonstrates that oversimplification of the association between SES and asthma is unwarranted and that the relation between SES and asthma in developing countries may have its own distinct features. ■

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Contributors

R.J. Rona, H. Amigo, and P. Bustos originated the project. C. Corvalán planned the analysis with R.J. Rona, carried out the analyses, and wrote the article. R. Rona supervised the analyses and assisted C. Corvalán to draft the article. H. Amigo and P. Bustos supervised the implementation of the project. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article and approved the final version.

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Human Participation Protection

Ethical approval for the study was obtained from the ethics committee of the Medical School of the University of Chile.

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